User scenarios 2020

a worldwide wireless future

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EXECUTIVE SUMMARY

Developments in wireless technologies have, worldwide, changed the way users communicate, work, socialise and learn. Wireless technologies have stepped into users' daily life and can be expected to become an even more daily commodity in the future. This paper presents work carried out in the World Wireless Research Forum, WWRF, Working Group 1 on Human Perspectives and Future Services. With the WWRF vision for 2017; "7 trillion wireless devices serving 7 billion people by 2017", a number of user focused scenarios have been developed to provide a set of worldwide future pictures reflecting the vision.

A total of 7 scenarios were developed providing an insight into users' daily life activities in relation to private, public and business spheres. One scenario goes across these spheres and describes the daily life of one user while acting through a part of day. This scenario has small vignettes added with small stories of how single scenes could act out in other counties. Furthermore, one of the vignettes specifically addresses the large number of sensors/machines, which are inherently behind the WWRF vision. The scenarios address users in Australia, Kenya, Argentina, USA, Germany and China.

Inherently in the scenarios are assumptions and expected user requirements. A selected list of these is outlined in the end of the document.

The work on the scenarios has been supported heavily by other WWRF Working Groups. It is the hope that the scenarios can be used to discuss and challenge expectations to future technology developments and to develop further some of the use cases inherently part of the scenarios.

The scenarios, the work behind and trends in user requirements behind the scenarios are presented in the paper.

1 INTRODUCTION

For years, telecommunications and IT have represented highly profitable business areas with continuous developments of technologies, devices and services to serve all types of users. During the years, it has become evident that there may be a discrepancy in relation to what technically can be achieved and what users will want, accept and buy. Increasingly resources are put into understanding user behaviour and requirements in relation to mobile wireless technologies. Furthermore, there is a growing awareness and recognition that the process of identifying user requirements is the most important phase within system development (Flynn and Jazi, 1998), and that the primary reason for systems to fail is the lack of poor and inadequate requirements (Ovaska et al, 2005; Sharp et al., 2007). Imaz (2006) adds that user requirements must be understood and data interpreted in such a way that all various competences involved in the development of the system, such as those who will interact with the system, those who will programme it, managers, customers, clients and other stakeholders will understand it.

One approach to gain understanding of user requirements is to develop user-focused scenarios. Scenarios are widely used to display possible futures, and they are often used in user requirement elicitation processes to provide ideas and identify user requirements, to explore different possibilities for use of future technologies, and for developing new technologies and services (Sasse, 2006). This paper presents a number of scenarios for 2020 representing different users around the world. All scenarios have a user-centric focus, meaning that it is the users and the actions users perform that are in focus. Guesses on which technologies or services that may serve the users in their actions will be up to the reader and are therefore omitted in the scenario descriptions. Note, that the scenarios not only represent different users but also different IT infrastructures, markets and political systems. These factors have been taken into consideration in the formulation of the scenarios and mean that there will be a relatively large differences between the different scenarios in the level of advanced use of wireless technologies.

As a fundamental basis and reflector point for the scenarios, the World Wireless Research Forum (WWRF) vision for 2020[1] has been used:*"7 trillion wireless devices serving 7 billion people by 2017"* (Tafazolli, 2006).

Behind this vision lie a number of assumptions (Tafazolli, 2006):

- Users are able to access services with the best match of their preferences and environment anytime and anywhere
- Context-aware applications provide services and applications with the best match of the user preferences and environment
- The future mobile communication system will be based on the Internet protocol family

[1] Originally, the vision was developed for the year 2017. However, work within WWRF has extended the time period to 2020 and therefore, the scenarios are targeted at this year as well.

- The heterogeneous networks of the future will be embraced by Ambient Networks so that the networks appear homogeneous to the potential users of the services
- Users are treated as owners and operators of their own special, low-complexity networks in inter-vehicle networks, body area networks and sensor networks
- The future systems will be characterized by the convergence of mobile systems and IP networks operating over a common access infrastructure (B3G radio access structure)
- Cognitive networks are seen as a major building stone for the vision
- Cooperation among different networks assumes that different technologies such as cellular 2G/2.5G/3G mobile networks, BRAN/WLAN, and DVB can be components of a heterogeneous wireless-access infrastructure and cooperate in an optimal way to provide high speed and reliable connectivity anywhere and anytime.

These trends and visions are the optimal forward pushed visions. Another central perspective related to the WWRF vision is the number of devices per user. It is of course not expected that users will directly/personally command 1000 devices meaning that a fair number of the devices is expected to be machines/sensors. It is, therefore, assumed that at large part of the communication in 2020 will be machine-machine communications including sensor related communication.

Today, there are tremendous geographical and cultural differences in the world and in terms of use and deployment and development of mobile technologies and IT infrastructures (see for example International Telecoms Union, 2006). Expectations are that this is also the case in 2020.

Since the scenarios represent different users from around a future world, the philosophy behind the scenarios has been to focus on central daily life activities that users will continue to do; however, new advances in wireless technologies may change how the activities are carried out and by which means. The scenarios presented here address three different so-called user spheres: the residential sphere, the business sphere and the public/health sphere. This is to represent users in all parts of life. Two scenarios were developed within each sphere: one representing a technology advanced country and one representing a less technology advanced country.

The paper is organised as follows: In section 2, the idea, assumptions and development process behind the scenarios are outlined. Section 3 presents two scenarios representing the residential sphere related to the USA and China. Section 4 presents scenarios linked to the business sphere related to Germany and Argentina. Section 5 presents scenarios associated with the public sphere in Australia and in Africa. Section 6 presents the so-called daily life scenario across the spheres. Section 7 identifies a list of requirements related to the scenarios. The conclusions are outlined in Section 8.

2 DEVELOPING THE SCENARIOS

The overall purpose of developing the scenarios was to gain insights into user requirements related to future wireless systems and to allow these to be the basis for discussing, within WWRF, challenges and possibilities for technical developments in the wireless systems around the world. Ideally, the construction of user-centric scenarios would be based on direct involvement of users enforcing the principles of user-centric design by application of for example contextual design or participatory design (Sharp et al., 2007). However, resources have not permitted this approach. The concept of user-centricity is, therefore, central for the scenarios.

The concept of user-centric scenarios is interpreted differently in different projects and settings. The concept of user-centric scenarios is here based on the definition given in (Sasse, 1996): "User-centric scenarios are based on individuals moving through different places over time, using a range of devices and applications". This involves describing a number of particular activities, different network services across a range of locations such as home, car, travelling, visiting family, etc. The scenario also describes what the users do in each place, with whom they communicate, the technical facilities available, the environment, the social organisation of this, etc. (Sasse, 1996). Furthermore, it may include supplementary details on machine-to-machine networks and communications, which indirectly support various user actions as well as possible different services and applications.

The scenarios presented here were derived using a futuristic template for the scenario construction. The template was built on Schwartz (1996) and van der Heijden (1997). In summary, the scenarios are constructed using the following approach:

- Identification of driving forces and fundamental drivers
- Identification of relevant driving forces to take into account fundamental uncertainties
- Selection of different scenario settings; locations, persons, focus and interaction with the wireless systems, devices and applications
- Identification of "amazing" or "wow" effects for each scenario
- Writing the scenarios
- Discussion of the impacts of the scenarios

Driving forces are elements, which move the plot of the scenario and vary between the scenarios. Fundamental drivers are elements, which have a reasonably high probability of coming true in all scenarios (Schwartz, 1996). The identified points cover overall technology trends, social and user perspectives, as well as environmental and economic perspectives in the wireless world.

In practice, this approach was followed by application of a combination of: literature studies including country reports and surveys (for example International Telecom Union (2006); UMTS Forum (2005); Pow and Moessner (2005); Aftelak (2004); Karlson et al. (2003); MAGNET Beyond (2006)); user requirement studies; interviews and questionnaires; feedback on scenario drafts (from WWRF delegates); and workshops on specific scenario elements. Details on this process can be found in Sørensen and Skouby (2006).

It was decided that the scenarios, geographically, should cover the global environment with elements from both the developing as well the developed world. Additionally, it was decided to construct the scenarios to represent the WWRF research interests and activities. The scenarios are, therefore, made up by:

- a combination of driving forces (elements which can be assessed at different levels in the various scenarios) as well as a number of fundamental drivers (which should be equally represented in all scenarios)
- a narrative (with selected pictures) which describes a user/group of users and how they interact with wireless technologies in daily life situations

To address different user profiles in different geographical areas of the world, six scenarios were constructed with varying focus on the gender and age, the user role (private, public, business) and the place. This ended in the following mix:

- A home environment (activities related to what users are doing in their homes and when carrying out activities related to being off work, such as shopping) in the USA respectively rural China
- A nomadic professional working environment in Germany respectively in Argentina
- A public, school and health related environment in Australia respectively in Kenya.

From a user point of view, this division of roles into different spheres has become artificial: Everyday, many users deal with private relations at work, bring work at home, go to school at a distance, etc. Therefore, one scenario has been created, the Daily Life Scenario, to focus on user activities over a longer time and across a variety of daily life activities. The Daily Life Scenario has been developed from the USA scenario above, and has been transferred to geographically represent Germany. As part of the Daily Life Scenario, small stories were placed in the text to represent one scene in the scenario and to show how the scene could have been played out in another country.

During the process, a long list of driving forces and fundamental drivers for the scenarios were derived. Examples on driving forces identified are:

- Developments will be more user driven
- User mobility will increase
- The service and application market will grow
- User security, integrity and privacy will become more important
- The market concentration in the wireless industry will change
- The fight for market dominance in the wireless industry will intensify
- Short terminal usage time and complexity management will become increasingly important problems

A full list of driving forces and fundamental drivers can be seen in the Annex.

The driving forces and the fundamental drivers cover overall technology trends, social and user perspectives, and environmental and economic perspectives in the wireless world. The elements are a combination between trends and forces identified in Karlson et al. (2003) and Tafazolli (2006), and expectations from involved WWRF representatives.

3 SCENARIOS: RESIDENTIAL ACTIVITIES

Residential activities cover a broad number of activities, which are linked to the home and to affiliated user spheres such as shopping, taking care of family members, being able to work to a certain extent in or around your home, etc. The following two scenarios each represent a different focus on the user activities related to residential activities. The first scenario is geographically focusing on California, USA, and on user activities relating to coming home from work and planning the activities around the house. The second scenario is geographically focusing on Rural China and activities around shopping.

3.1 HOME COMING, CALIFORNIA, USA

Prerequisites and focus

In many cultures around the world, managing the daily life at home is not constrained to being at home. For many knowledge and business workers, the daily life is mixed with the working life without clean-cut boarders between them. This scenario focuses on some of the basic human requirements when managing residential matters. The scenario looks at the needs for monitoring and dealing with the children to make sure that they are secure on their way home or in the home. Also the scenario deals with all the daily life issues that need to be taken care of. That includes grocery shopping, picking up children, cooking, communicating with friends/family and entertainment.

The scenario is related to a suburb in California. It could be a suburb as La Jolla North of San Diego, where a large percentage of people commute every day to and from the metropolitan area of San Diego. Because of the high density of people living and commuting, public mass transportation can be essential. In many American cities like San Diego, metros, trolleys and busses normally take care of the public mass transportation. In San Diego, there has been made proposals to build monorails on top of this[2]. The monorail thought is here taken a step forward and combined with an existing idea[3] on combining individual wagons/cars together to a sort of trolley or monorail, which then can be transported over specific transportation nets.

Also, the San Diego area (and perhaps most of California) is characterised by a high number of community groups, which work to unify the voice of the community in different questions and issues[4]. The need for communication within a community is also a focus point here.

Technologically, the scenario could focus on the handling of mesh-networks, establishment of secure and trusted network connections in public and private spheres, sensor networks in the private home, and e-commerce in push-pull relations.

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[2] http://en.wikipedia.org/wiki/San_Diego,_California

[3] http://www.ruf.dk/

[4] http://en.wikipedia.org/wiki/California

Business perspectives look into the construction of business models for individuals in the RUT (an extended trolley/monorail) connecting to a hosting network and using services on this. Also there are business perspectives related to ads and shopping, to setting up games and to establishing large networks for community communication.

For this scenario, the driving forces are represented at the levels as can be seen in Table 1.

Table 1 Level of driving forces in The Home Coming scenario

Driving force	Level assumed in the scenario
1 Developments will be more user driven	Medium
2 User mobility will increase	High
3 The service and application market will grow	High
4 User security, integrity and privacy become more important	High
5 Health related issues will become more central and important to users	Low
6 There will be a shortage of spectrum for certain applications	Medium
7 Environmental issues will become more important	Low
8 There will be a worldwide pos. development in the telecom and wireless industry	High
9 Short terminal usage time and complexity management will become increasingly important problems	Low

3.1.1 User scenario: Home Coming

What a day! It had been one of the busiest days in a very long time. Juliet took a deep breath and pushed the button to lock her car to the RUT (Rapid Urban Transport); an individual car, which can be linked to a group of other cars and transported together via a specific monorail type of line running above all other traffic[5]. Juliet is a 38-year-old woman working as a photographer in a big broadcasting company. News about the disaster in Mexico had filled the headlines all day and it was difficult to leave the company but she had to go home to take care of the children since her husband was away on a business trip. Fortunately, she could follow the development of the situation while she was linked to the RUT looking at the built-in screen. Using her personal mobile device, she can connect to the network available in the RUT and transfer her personal preferences in terms of what she would like to watch on television, whether she likes to listen to radio, or to use the built-in display to retrieve personal information such as e-mail, voice mail and maps showing where her children are at the time they are in contact. Furthermore, she likes to be able to continue working on her personal laptop in order to finish off some work while travelling.

[5] The RUT line is centrally directed like a train but with little cars, which can be dislocated at different locations and carry on individually. The RUT line exists as idea in Denmark: http://www.ruf.dk.

Juliet likes to use some of the advanced services on the RUT network. One of the specific services is that she can get information about other commuters on the RUT. Sometimes she discovers[6] friends who are commuting at the same time; since the commuting time is sometimes considered as "wasted time" it is a good chance to have a "friends" talk before she arrives at home to all the responsibilities there. On the other hand, she can also select not to be visible to others, if she does not want to be disturbed on the ride. This feature is turned on today. She is too preoccupied with watching the news on the disaster and spends this trip following the television news.

There is a fee for using the RUT technological network and the special services. However, Juliet thinks that the price is fine in particular when she has to spend almost two hours commuting every day.

While Juliet watches the latest news on the built-in display, she checks her personal mobile device for the location of her children. She can see that her two daughters, Jennifer (4 years old) and Mindy (8 years old) are on their way home with a special secure RUT (with a trusted driver), she had ordered today, to bring them safely home from the tour they had been on with the school and day care centre. When Carl, her husband, is away travelling as he is these days, she often orders this transport form to save time to be able to get to the house almost at the same time as the girls. Also she can see on the mobile device that her son, Steve (15 years old) is at home playing one of his virtual reality computer games.

Steve is in the gaming room in the house. Through his gaming device, he has established a connection to 10 of his schoolmates living in the suburb. Since he is organising the game today, he has been responsible for setting up the invitations for his friends to join. Fortunately, the gaming device is easy to use and he can simply mark the addresses on a map on his gaming device (or on a nearby screen) to which he wants to make a connection. Together, his friends and he have selected an Internet game to play today, and he accepts to be the person paying for the game today. Before he puts on the helmet to enter the virtual reality gaming world, he checks his mobile phone and gets a message that his mother is approaching the house. He makes sure to send her a message from his smart phone, so that she does not disturb him.

Juliet is now finally at home. After leaving the RUT, she had to drive her car the 3 km from the line to the home. Fortunately, she can retrieve information on special weather conditions or traffic problems, which is a service she often uses. This comforts her as she is getting off the RUT in the middle of the traffic peak hours. One km before she reached the house, a message is read aloud for her from the car communication system. She is asked about her personal preferences for the home. Already her personal preferences on temperature, lighting music, etc. have been set, but today she wants something else. She suddenly remembers that her best colleague had transferred some new music to her mobile music device just as she was to leave work. She decides to listen to the music when entering the house and transfers the music to the house server, then accepts her personal

[6] Using her mobile device.

house settings (from the car) and, by voice, adds that the music has to be played in the living room when she enters the house.

Getting out of the car, a message prompts her and she is informed that her son plays a game. She quickly thinks about her preferred house settings and remember that the gaming room is set (by default) to as it is.

At home, Juliet enjoys the new music following her way through the house. Entering the kitchen, she watches the display on the wall. Here she gets automatic messages on the groceries she had ordered yesterday as well as she can get exact stock status of different products in the house.

On the display in the kitchen, she got suggestions for different dishes she would be able to cook given the groceries status in the house. Rarely, the synchronizations between the new groceries and the stock in the house (in cupboards and the refrigerator) were wrong. However, more than once (for example at Carl's birthday dinner last year where they expected 20 visitors) she had discovered problems and had been without essential items such as flour. Fortunately, her next-door neighbour had some, so this particular birthday cake was saved. The little problems she had anticipated with this system made her uneasy, and often she just disconnected this and found out about the stocking of groceries by looking – just as they always had done in her home when she was a child herself.

Now, Juliet gets a message on her personal mobile device that her daughters are 2 km away. While she gets ready to pick them up by the door, she gets a new reminder. The community meeting! Tonight, the whole suburb will get together to discuss the location of a new RUT line through the outskirts of the suburb. These community meetings are held virtually as a videoconference, making it possible for every household (20.000 households) in the community to participate. Juliet opens the door and smiles – cooking, the meeting, more work – all which will have to wait till she has hugged her daughters.

3. 2 SHOPPING IN RURAL CHINA

Prerequisites and focus

Technology adaptation in rural areas of Asia is rising exponentially and is expected to continue over the coming years[7]. In China, today, more than half of the population lives in rural areas. Currently, China has a penetration rate on mobile phones of 33% and this is expected to rise over the years and therefore also expected to have significant effect on rural areas[7].

The scenario sets focus on rural China and expected and likely achievements in this area. Focus is on a young adult that goes shopping. Different services are being put forward for the user, but at a relatively low cost or no cost. It is expected that most services offered in rural China will be available for everyone.

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[7] http://en.wikipedia.org/Media_in_the_People%27_Republic_of_China

Focus of the scenario is on the broad usage of mobile smart phones and RFID tags combined with search technology. Security plays a small role but is not limiting peoples' usage of the mobile smart phones. Networks and hotspots are expected to be present at most locations; however, there may be some problems with stability and interruptions of communication.

The following table 2 shows the levels of the different driving forces underlying the Rural Shopping scenario.

Table 2 Level of driving forces in The Rural Shopping scenario

Driving force	Level assumed in the scenario
1. Developments will be more user driven	Medium
2. User mobility will increase	High
3. The service and application market will grow	High
4. User security, integrity and privacy become more important	Low
5. Health related issues will become more central and important to users	Low
6. There will be a shortage of spectrum for certain applications	Low
7. Environmental issues will become more important	Low
8. There will be a worldwide pos. development in the telecom and wireless industry	Medium
9. Short terminal usage time and complexity management will become increasingly important problems	Low

3.2.1 User scenario: Rural Shopping

It is Saturday morning and Chenyu (age 27) leaves the house. She lives with her small family (husband and son) and her mother around 150 km west of Shanghai. Today the big market is open. The market is situated around 40 km away from her house. She has plans to do some grocery shopping but also to buy some clothes for her small son. Chenyu has brought her smart mobile phone. Almost everyone in her neighbourhood has a smart mobile phone, which is used for all kinds of things such as payment, e-mail, SMS, MMS and voice, camera, and of course calendar and data base storage of different data – beyond keeping in contact with friends and relatives. Chenyu is a relatively experienced user of most features of the smart phone however many of her friends only use the device for simple communication and payment.

Chenyu takes the local bus the 40 km to the market. Entering the bus, she accepts the e-ticket sent to her on her mobile phone and pays also using her mobile phone. She spends the travelling time on the bus watching Chinese news on her smart phone (for such small trips she can live with the small screen), and she e-mails with her friends. She prefers to use her office work e-mail account in order to have the right level of security attached to her e-mail. Once she has had the experience that another man (from another country) was using her private e-mail account. The account was all of a

sudden reconfigured and her personal mail had been deleted. After that she decided to discard the private e-mail account for which she actually paid a fee.

Approaching the market, Chenyu decides to search for the prices and availability of goods in the different shops of the market. She can log on to the market web page and use the search facilities presented there. Searching for goods only cost a small symbolic fee (for which she also can pay through her mobile phone) and will in the end save her for some time looking for the more specialised goods that her mother requested. She can, with her smart phone, search for specific groceries and get tentative price for these (bidding is still the custom at the market). If she wants to purchase or see the things, she can download a map with a description of how she can find the special shop. Today, she accepts the fee for a map with the location of all the shops she has selected to visit, and the map is downloaded and stored on her smart phone.

Finally, at the bus end station, Chenyu leaves the bus and walks the few hundred meters to the entrance of the market. The market is situated in a large old building with room enough for almost hundred people selling clothes, groceries, vegetables, accessories, shoes, etc. Entering the market, Chenyu receives small ads from the different shops. The first time, she entered the market she was completely spammed with ads. After that experience she has a personal profile set-up for accepting ads for special goods and from preferred shops only. However, since she already searched for the goods she wants, she choose to disregard all incoming adds – still allowing for messages or calls from her family and friends to come through.

After having bought everything on her list, she just wanders around and looks for a place to get something to drink. All of a sudden, she realizes that she needs to by a present (a shirt) for her 13-year-old nephew, too. She almost forgot his birthday, which is in one week from now! For her closest family (husband, son and mother) she has information on size and even 3D pictures of them stored on the smart phone. But when it comes to her nephew, she is more in the dark. She finds two shirts that might be suitable but decides to ask her older cousin about her opinion. Her cousin works and lives in Shanghai and has a 14-year-old son herself and she will therefore be a good advisor in this matter. Chenyu dials up to her cousin's phone, transfers pictures of the two shirts as well as details on the fabrics and engages in a small e-mail communication back and forth. Finally she decides (they agree) on one of the shirts and interrupts the communication with her cousin. Chenyu then buys the shirt and makes sure that the shopkeeper marks the shirt in such a way that it can be exchanged if the nephew doesn't like it after all.

Finally, she is done, and when she leaves the market, she receives a message automatically on the total costs for ads, searches and location maps. She accepts the bill and payment while entering the bus going home. She now looks forward to getting back home to spend the rest of the day with her own son.

4 SCENARIOS: BUSINESS ACTIVITIES

Two scenarios were developed in order to focus on user-centred business perspectives. The first scenario takes place in Frankfurt, Germany, and represents a highly professional and technical demanding business environment. The second scenario focuses on business in a smaller scale in Argentina. This scenario differs from the first scenario in respect to the environment (lower population and fewer technology possibilities) and in respect to long distance business cooperation using legacy systems.

4.1 THE INTERVIEW IN FRANKFURT, GERMANY

Prerequisites and focus

The scenario focuses on a high-density professional business environment, Frankfurt. It can be assumed that for this scenario, Svend (the main character in the scenario) represents a large group of users requesting the same sort of capabilities and resources. Already now, Frankfurt is a metropolis in terms of international business with around 320,000 companies situated in the city[8]. The region is considered to be one of the most productive regions in Europe and is an international financial centre of Europe[8]. Also it is expected that the need for office space in Frankfurt will continue for the years to come and therefore, indirectly, the need for technology support of a large group of users will have to be developed.

The scenario focuses on a media journalist as a representative for a large number of knowledge and business workers around the world. The knowledge worker/journalist is characterised by being highly mobile and with high demands on bandwidth, seamless connectivity and security.

The scenario assumes that Svend's businesses take place seamlessly with the use of a cellular set-up in Frankfurt – as one of the wireless technologies in the area. This is to illustrate issues and challenges in respect to particularly spectrum capacity and cognitive radio usage.

As a professional businessperson, the user in the scenario does not consider payment for the advanced services to be an issue. However, there are business perspectives to explore when it comes to the sharing and engagement of operators when capacity needs are not met with the work offices normal network capacity. Table 3 shows the levels of the fundamental drivers for The Journalist scenario.

[8] http://www.frankfurt-business.dk

Table 3 Level of driving forces in The Journalist scenario

Driving force	Level assumed in the scenario
1. Developments will be more user driven	High
2. User mobility will increase	High
3. The service and application market will grow	High
4. User security, integrity and privacy become more important	High
5. Health related issues will become more central and important to users	Low
6. There will be a shortage of spectrum for certain applications	High
7. Environmental issues will become more important	Low
8. There will be a worldwide pos. development in the telecom and wireless industry	High
9. Short terminal usage time and complexity management will become increasingly important problems	Low

4.1.1 USER SCENARIO: THE JOURNALIST

Svend finishes his videoconference with Juliet (living in California). It was pure luck that she accepted his request for a conference and that she was willing to help him. Svend is an old friend of Juliet. They have worked together in a broadcasting company in the US; but 2 years ago, Svend moved back to his home country, Germany, where he now works as a news reporter in one of the big broadcasting companies. The company is located in the middle of the business district in Frankfurt.

Svend is currently working on a documentary about a top European politician. He remembered that Juliet some years ago was involved in making a documentary on this same person's relation to a chemical company in California. He wanted to have all the details from this work including material, which was not previously used. Fortunately, Juliet was willing (and able) to log on to her work server from her home in California, and to establish a secure connection to his pc and simultaneously to his extra capacity PDA. This means that he could watch the program (on his extra capacity PDA) while moving around his office environment and even going outside the office building to drink coffee in the small café across the street.

Suddenly, he is prompted by a message from his corporate calendar in the PDA. There has been a change in the calendar for today! At the same time, his mobile smart phone calls and his secretary tells him that she has succeeded in making an appointment with the best friend to the politician. However, the interview has to take place within half an hour in a café nearby. With his smart phone he calls a taxi. This particular taxi service locates the taxi nearest to his office location to save time. During the taxi ride to the café he looks at the programme on his PDA, while he edits comments to special sequences or statements on the reportage. This is simultaneously and seamlessly being

transferred and saved to his pc through the sensor hotspots in the car and the vicinity. Using this feature in the taxi costs extra, and is automatically charged to the taxi bill when he leaves the car. Payment is done via his smart phone and the bill is electronically sent to his company for documentation.

In the café he finds the table reserved for him (he has an efficient secretary). Svend then sets up the PDA so that it can digitally record the interview with audio and video. Also he sets up a secure line to his office pc to stream the interview directly to the pc for back-up purposes. He hopes that the PDA has enough battery power for the whole interview. Otherwise, he has to set up his smart phone enabling him to record a bit more (the capacity of the smart phone was even smaller than the PDA's).

The politician's friend arrives punctually. Wirelessly, they exchange business cards through their smart phones. Svend has different predefined business cards for such kind of official events. The card is a multi-media document, which displays relevant information about Svend. This particular card includes a special phone number, which can reach Svend at any time. Just in case….

The interview goes well and Svend gets additional material for his documentary. He looks through the interview session again while driving back in the taxi. There is a good chance that this documentary can be broadcasted in just a few days. While leaving the café he accepts payment for the lunch on his smart phone. Also he receives electronically a map and a web-link to the shop where the special bread from his lunch is bought – the bread was excellent. He provides the map information to the taxi's management system, so that the driver more easily can find the shop. Svend decides that this little detour is a good way to celebrate the successful interview.

4.2 BUSINESS IN ARGENTINA

Prerequisites and focus

Argentina has an old tradition for exporting goods to (amongst others) Europe: Many Argentineans originates from European countries and have in that way paved the way for performing business today. The export industry centres about food, meat and manufacturing products[9]. This scenario takes place around the large city of Mendoza in the middle of the wine district of Argentina. Argentina is a worldwide number 5 in wine production[9]. Wine serves as a source of income in different ways: As an agricultural product to be sold in Argentina and exported to other countries, and as a tourist attraction with possibilities to stay on the winery for some time. This scenario takes place on a large winery with exports to Europe and a growing tourism.

Looking at a winery in Argentina, in 2020, gives several challenges technologically: a large winery with tourism can be assumed to be open to adaptation and implementation of wireless technologies. On the other hand will the location of such a winery give certain limitations to the type of

[9] http://en.wikipedia.org/wiki/Argentina

technologies, which can be implemented; to the number of operators, which can be assumed to operate in that location; and perhaps to the quality of service, electricity availability and the robustness of network connections. The export perspective for such a winery will, again technologically, demand a certain electronic handling of communication, billing and payment to make a smooth business with European partners. This will again demand a certain level of security in spite of perhaps problems with trusting network connections and shortages in electricity.

Today, radio technology is important in Argentina. This is expected to be the case also in 2020 at least for older people and as a backup if Internet connections are unstable.

Technologically, this scenario focuses on radio technology, RFID tagging, Information Systems for export business, simple wireless communication over WiMAX or similar technologies, security and problems with display and battery time. Table 4 shows the presence of the driving forces in this scenario.

Table 4 Level of driving forces in the Wine Business scenario

Driving force	Level assumed in the scenario
1. Developments will be more user driven	Medium
2. User mobility will increase	Medium
3. The service and application market will grow	Medium
4. User security, integrity and privacy become more important	Medium
5. Health related issues will become more central and important to users	Low
6. There will be a shortage of spectrum for certain applications	Low
7. Environmental issues will become more important	High
8. There will be a worldwide pos. development in the telecom and wireless industry	Low
9. Short terminal usage time and complexity management will become increasingly important problems	Medium

4.2.1 User scenario: Wine Business

The landscape was spectacular: the Andes Mountains hovering in the East and lush wine and fruits growing as far as can be seen in all other directions. It was morning and the owner of the winery, Pedro Salazar and his 28-year-old daughter Esmeralda waited for the 4-wheel drive to stop in the yard. In the car, a group of 5 persons were seated. They were a group of tourists to stay on the winery for the coming week. It was always a bit exciting to meet the persons behind the names on the paper. Esmeralda welcomed the five women and showed them to their rooms. One of the women held in her hand a smart mobile phone and started immediately to press several buttons. The woman turned out to be the director of a small company and she was trying to establish contact with her vice-director back in Belgium. Esmeralda sensed that this woman could end up causing some problems – she seemed stressed and not at all focusing on the winery and her stay there. Esmeralda

therefore introduced the woman to the winery's Internet services and made her pay for her expected usage for the next week. That hopefully could ease the stressed director.

After welcoming the tourist group, Pedro Salazar headed for his car. It was a busy day where he and his men would be checking a large amount of the wine stocks and had to supervise bottling of the first barrel of the organic wine. Organic wine was a new product from the Salazar winery. However, it was now a clear demand from the Dutch customers: organic wines had been upcoming for years and a large percentage of their customers wouldn't buy anything but that. Pedro was not so sure about the quality but he knew that the wine would be documented in the right way to satisfy the demanding customers.

Pedro stopped the car around 2 km from the hacienda. A group of his men were working in the field checking the wine stocks. Pedro looked at his mobile smart phone. There he could find the details on the wine stocks they were checking right now. One of his men had all morning been making some adjustments to the fertilising of some of the new grape stocks, and had tried to update the tags on the stocks next to the plants. However, his mobile device failed (the display couldn't manage the heat or the batteries failed in humid weather – problems they unfortunately often encountered) and therefore, Pedro must now make the changes to the stock tags and at the same time update his own mobile smart phone. The information was then updated on Pedro's mobile smart phone so that he later could place this information on the information system on his laptop so that the information could be visible for the export partners in Europe as well. This was all a part of the increased documentation procedure for wine production combined with the increasing environmentalism in the world.

It was almost lunchtime now. Pedro and three of his men headed back to the yard where they were to start up the testing of the wine that had to be bottled today. They all entered the wine cellar that was nicely tempered and therefore a good place to spend time before lunch. They all took part in the exciting procedure opening the barrel, smelling and tasting the new wine and putting the first wine into their first organic wine bottles. It was a big moment. The bottles were tagged with a summary of the information from the wine stocks making sure that the customers could see the documentation on the handling of the wine.

Pedro and his men spent lunch with the group of female tourists. They were settling in and were excited about spending one week, learn about wine and take part (on a small scale) in the wine production. However, the director spent most of the lunch complaining about the unreliable internet connection and the problem in choosing another operator for the overseas communication.

In the afternoon, Pedro went into his office. Pedro started the laptop and gained access to his information system. He would like to update the availability of different wines (what was still on stock) and to check whether new orders had been placed from his partner in Europe to whom he exported a relatively large amount of his wine. Often this process was taken care of by his daughter but today Esmeralda was managing the tourists. However, it was very difficult for Pedro Salazar to remember all passwords and settings to get the right information and he only managed because he had made copies of all the codes and screens and kept these in his drawer (a secret that not even his daughter knew about). After updating and transferring the data, he made a copy of the status line,

which was confirmed by their partner in Europe. The paper copy would document the process and the agreement if the system went down before he had saved the data properly. Twice, the system had gone down due to a sudden electricity deficit and it had been a lot of work to re-gain access to the data again. After that, they had the simple paper printing process as a backup and hoped that the paper printing would take place before another electricity “break down”.

He heard the little sound of a message popping in for him on his mobile phone. Esmeralda wanted him to choose the wine for the dinner. He immediately locked the door and went back to the stables. It was a warm evening with an incredible smell of food in the air. He knew exactly which wine would be good and started searching for the wine in his database on the mobile smart phone to find the location of the wine before he entered the building. This wine would close the mouth of the director – and with the concert broadcasted this evening, it would be a nice evening.

5 SCENARIOS: PUBLIC SERVICES

Communicating and interaction with public services of some kind is important in most societies. The following two scenarios have been developed each focusing on different interaction with the public services and systems. The first scenario takes place in Kenya and focuses on distant teaching/education. The second scenario focuses on health care and the communication with hospital services in Australia.

5.1 THE VIRTUAL SCHOOL IN KENYA

Prerequisites and focus

Worldwide education is the key to economic and social development. In many low-income countries, the enrolment rate of children to primary and secondary schools is a major concern for the governments. In these years, several initiatives have been created in order to produce and offer a cheap laptop so that all students in low-income countries will have the ability (probably with the help of the local government or school) to pursue such a device and in that way ease the way to better learning and understanding of the technology and Internet.

Kenya is a low-income country where a relatively high percentage (around 85%) of all children go to school[10] and therefore already now political focus is on the education perspective. This scenario focuses on e-learning perspectives in Kenya. In the scenario, the idea about offering relatively cheap laptops is used as a factor to enhance higher education and as a factor for offering distant learning.

The scenario focuses mainly on the features of Internet applications and browsers in 2020: context awareness, privatisation and trust issues are here relatively important. Cheap computers can today work as basis for creating ad hoc networks/mesh networks, and this perspective is underlined in the scenario as well, since it is expected to be a feature of technologies in the future in low income countries in more rural areas.

Table 5 shows levels of the different driving forces in The School scenario.

[10] http://www.africa.upenn.edu/NEH/keducation.htm

Table 5 Level of driving forces in the School scenario

Driving force	Level assumed in the scenario
1. Developments will be more user driven	High
2. User mobility will increase	Medium
3. The service and application market will grow	High
4. User security, integrity and privacy become more important	High
5. Health related issues will become more central and important to users	Medium
6. There will be a shortage of spectrum for certain applications	Low
7. Environmental issues will become more important	Low
8. There will be a worldwide pos. development in the telecom and wireless industry	Medium
9. Short terminal usage time and complexity management will become increasingly important problems	Low

5.1.1 User scenario: The School

It's early morning and Ama wakes up and reaches for her smart phone to see if there are any messages from her best friend. Ama lives in a village in the north of Kenya close to the Ethiopian boarder. She is 18 years old and still lives with her parents and younger siblings. She has recently started in the distance learning history class at the university. Ama just recently got a mini laptop, which is essential for her to be able to stay at home and at the same time go to school. Her mother is ill, and this way of being at home and at the same time going to school allows her to support the mother in the daily activities in the family. Ama dreams of becoming a history teacher herself.

The mini laptop was sent from the university and she is allowed to borrow the laptop for as long as she is enrolled as a student. All students receive such an offer making it easy for the students to follow the classes, which almost all of them are given also as e-learning classes. That has increased the rate of students engaging in a higher education since they can now stay at home while at the same time go to school and in that way lower the expenditure for their family. Many of the students attending the university live far from the university and a good number of them live a kind of nomadic life.

Ama logs on to the university history class via her mini laptop. The display immediately shows the teacher and in another small window a student talking to the teacher. It is a pre-defined setting that the display shows the teacher and always the student who is speaking. In her profile, she has defined three other windows: her three best friends from the class. Two of her friends lived almost 100 km away, so it was good to see their faces in this way. The last friend lived just 50 m away. However, today she could see that two of her friends have denied her access to have their pictures displayed. Hm, Ama concluded that both of them perhaps had been out too long last night so they probably were looking rather tired.

The teacher was now asking the students to do a project on the history of Kenya. They were to use all available resources and compose a document with text, audio/video clips, and links to relevant sites with more info and for references in general. Ama had tried that only one time before and she found out that it was a bit difficult to ask the right questions in the browser to limit the hits she would get. She had found out that she had to make searches all over again if she hadn't made specific bookmarks on information or even just sequences of information to a homepage. This happened because the Internet operator at all times could reallocate a certain part of the server space on these devices to optimise capacity of the net

Ama finishes today's class and prints out the project description: she wants to have the project description near her to read when she has a break where she has to take care of her small baby brother. Immediately after disconnecting from the school class, she sees a message on her smart phone. The message is a piece of information telling about the coming referendum. The smart phone holds back all such services while she is following the class unless the information has such a high priority that all people must see it immediately. Only the government can send such high priority messages.

Now, her mother calls: the smallest baby brother needs to have a bath. Ama brings her smart phone and starts her baby brothers' favourite lullaby. The smart phone fortunately has speakers, which makes it possible to share music also in the "old fashioned" way. Music always relaxes the baby brother and hopefully makes it possible to bath him relatively quickly, so that she can be ready for the next class in just half an hour.

5.2 TREATMENT AT THE HOSPITAL, SYDNEY, AUSTRALIA

Prerequisites and focus

Health care and management of health related issues is a world-wide issue which is expected to increase in importance over the coming 10-20 years: the number of deaths caused by chronic diseases is estimated to be 41 million persons worldwide by 2015 – a significant rise compared with numbers from 2005[11] . This will naturally be a major problem in economic terms (it will create a loss in terms of income and expenditure in terms of treatment) and some challenges in treatment of people across borders (since it can be expected that mobility of people will naturally increase – chronic disease or not). One basic requirement for the future (and in the present time) will be to be able to receive the right level of basic treatment for all users everywhere.

The scenario focuses on an elderly couple that travel and at the same time need to be supervised in terms of the functioning of a pacemaker. In particular when it comes to elderly persons, there is an increased need for monitoring of diseases and treatments compared with young adults (who often will like to manage their own diseases and treatments to the level they can).

[11] WHO: Chronic Diseases could kill 35 million in 2005. TWN: Info Service on Health Issues No. 11, October 11, 2005

In the scenario, the couple is from India travelling to Australia. The couple must be assumed to represent the upper layers of society and therefore also in terms of health care treatment. Sydney, Australia is already today a well-developed city with a high level of care taking and hospital equipment.

In the scenario there is specifically mentioned location based services for which payment is required. In the contact between the hospital and the patient, there is also mentioned payment for the treatment, however, without any details on how that could take place. It will be most likely that the hospital service needs some kind of business model either as a direct contact with the patient or an indirect payment between the hospitals (so that the patient has a pre-specified rate for all types of treatment in terms of the pacemaker with his home hospital – and that this rate is unaffected by the place he is treated).

Technologically, the scenario will have included special consideration and requirements to the handling of security perspectives, machine-to-machine communication, BANs, interference between airwaves, medical equipment and the pacemaker, as well as location based services.

Table 6 Level of driving forces in The Pace Maker scenario

Driving force	Level assumed in the scenario
1. Developments will be more user driven	Low
2. User mobility will increase	High
3. The service and application market will grow	High
4. User security, integrity and privacy become more important	High
5. Health related issues will become more central and important to users	High
6. There will be a shortage of spectrum for certain applications	Medium
7. Environmental issues will become more important	Low
8. There will be a worldwide pos. development in the telecom and wireless industry	High
9. Short terminal usage time and complexity management will become increasingly important problems	Low

6.2.1 User scenario: The Pacemaker

It is early morning; Nandita (64 year old) wakes up and sees her husband Nawal (68 years old) already dressed sitting in a chair. Nawal explains to her that there is some kind of problem with his heart. Two years ago, Nawal had an intelligent pacemaker inserted. Normally, the heart centre in Calcutta can make remote adjustments of the pacemaker so that it all the time runs optimally. Nawal is in that way saved from many trips to the hospital and it leaves him with a good feeling that he is well taken care of. Only once before, the hospital has made a request (on his personal,

mobile device) for him to come in person to the hospital and they had sent an ambulance to accompany him directly to the centre. That had been a bit worrying but the hospital had arranged for everything. And the situation was easily solved: The pacemaker was charged with extra energy and then worked optimally again.

But now he was in Sydney. Nandita had for years begged him to go to Sydney to visit some of their very old friends. The operation a few years ago had delayed the trip but now they were here. Unfortunately, Nawal almost thought. What is the procedure now being in a foreign country?

Nandita checks her personal, mobile device and sees that the there is a message from their home heart centre (when it comes to Nawal's health, they decided that she would receive the same messages as him just in case). The heart centre has sent a voice message (not prompted by Nawal), which directs Nawal to go to a specific hospital in Sydney. The message reassures that there probably isn't anything seriously wrong with the pacemaker or Nawal, but just to make sure, they are asked to get it checked. The recommended Sydney hospital is informed about their incoming and they will send an ambulance within 20 minutes. However, since the hospital does not know Nawal and Nandita, they are asked to go through a special security procedure with the ambulance personnel in order to not make any mistakes in respect to who Nawal is and his needs at the hospital.

Entering the hospital in Sydney, Nandita suddenly realises that there may be a language issue. However, immediately when entering the hospital, Nawal's personal, mobile device starts downloading translation software that can be used in connection with the data in the device. At the same time Nandita's mobile phone is automatically muted not to disturb during the examination.

In the heart centre at the hospital in Sydney, Nawal again needs to ID himself, this time using his mobile device, which is authenticated wirelessly with the hospital server. The doctor in the heart centre examines Nawal and requests information on the operation and the pacemaker. Nawal's mobile device includes such information (audio, multi-media documents, data from measurements in the pacemaker) with video clips from the operation. Nawal allows the doctor to get to this information. Nawal makes sure only to allow the doctor to get relevant information; other personal information is not made available. Automatically, the translation system is applied to the multi-media documents, etc., making it easy to understand.

After one hour, Nawal and Nandita can go out into the sun again. A mistake had occurred, probably some kind of interference problem, which then resulted in distorted data measurements. When Nawal and Nandita leave the hospital, Nandita's mobile automatically activates and a message pops up on Nawal's mobile device to accept the payment for the examination. Nandita activates her PDA and selects a service, which can direct them back to the hotel guiding them the most interesting way. This service is charged directly to Nandita's PDA. It is going to be a nice day after all.

6. SCENARIO: DAILY LIFE IN 2020

Scene 1: Train ride – managing home/work related issues

Sabine runs onto the train in Karlsruhe and as soon as she enters, the door closes! That was close! She packs the dripping umbrella, and takes out her mobile personal device, which has automatically detected that she has entered the train and therefore asks whether she would like to find a free seat – and what the criteria for this seat should be. Normally, Sabine would ask for a seat next to a friend – if any friends were travelling on the train and if such a seat were available. Then she would automatically make a reservation for such a seat and this would be indicated at the seat so others were unable to take it. The train services knew beforehand who she had defined as friends, would check the availability of the friends (they could be engaged elsewhere) and knew her preferences for that particular question, seats, etc. However, today Sabine chooses to find a seat alone in the working section of the train. There are still some things she needs to finish from work before she can call it a day.

Sydney, Australia

Peter enters the hotel room and starts putting on his running gear. It has been a hard and long day with lots of business meetings. Now he looks forward to getting out into the sunshine. It is Peter's first visit to Sydney and frankly he has no idea on where to go from the hotel. He normally prefers to combine his running and very few spare hours with just a little sightseeing when he is travelling. So Peter takes his smart watch and logs on to the social networking portal that allows him to go into all his web-connections/ applications. He quickly asks for finding maps with ideas on running tacks in Sydney (the area of the hotel is already placed in the location field and is used as basis for the selection) or even better contacts that also run in Sydney and perhaps can be of assistance in finding a fine track.

Peter only waits a few minutes and several matches come up. However, one match seems better than the others; there is a contact person, Bob, an Australian, who is almost on his way to start his running trip. He lives only 3 km's from Peter's hotel, and he suggests that they meet somewhere in between. Bob knows a track, which will take them across a beautiful part of Sydney with views to the Sydney Opera House and Sydney Harbour Bridge. Peter accepts, and they agree to meet in around 15 minutes. That gives Peter enough time to chat briefly with his son home in England, and to see a reminder on sending a paper to a colleague.

Leaving the hotel, Peter now uses his smart watch to navigate towards the meeting spot with Bob. Both Bob and Peter can now see a map that shows their presence and at the same time guides Peter to the meeting point. Peter now uses the voice service from the watch, which allow him just to look around and not think too much finding his way.

One hour later Peter is back in the hotel. It was a great run. Peter can automatically look through the track (on the watch). He decides to send the map to another friend he knows will be in Sydney in a month time. Before going into the shower, Peter changes his presence profile on all Internet applications so he can be reached again. A new message pops up asking Peter if he would like to join one of the business colleagues for a drink later in the Sydney centre. Peter accepts and they exchange information on when and where to meet. Being away from home is of course a problem when it comes to his family but in most other aspects Peter feels at home almost anywhere he travels.

When she enters the working section of the train, the display changes again on the personal device. She is asked which services she requires in terms of working facilities. Since she commutes every day, most of her personal work profile requirements in this context have already been set per default and she chooses to make use of this today. Seated she can now switch her small mobile personal device directly over to the large screen on the back of the seat in front of her and she can also switch to the large keyboard available. She can choose to work using her personal device through the wireless connection or she can work using her personal information base that she can gain access to anywhere and from any

platform. Today she needs to access data from her work server and establishes a secure line in order to be able to get the data piece she needs to finish on the trip.

Her phone now rings with a very soft tone that she almost cannot hear. Since she is in the working section of the train, she knows that her phone will only ring if it is something really important from one of her family members.

Ulrich, Sabine's husband, is on the phone; He will be late and will, therefore not be able to pick up their two daughters Anna (8 years old) and Lea (4 years old) – he is currently in Würzburg on business and knows that Sabine will be too late to pick-up the girls since she has another engagement on her way home from the train. Quickly, Sabine decides to order a pick-up service from the school (a trusted person from the school who will pick up the children and take them home). The service is expensive but in this situation it is necessary and it can all be taken care of electronically with short notice. Her "order" is accepted after she has been authorised as the mother of the two girls, and Sabine can now send (voice) messages to Anna and Lea about the pick-up. At the same time she checks on Lukas, their 15-year-old son – is he home from school or? She receives a text message from Lukas' mobile that he does not wish to be disturbed unless it is very important since he is playing an interactive game at home. Sabine receives this particular message, but if others (non-family members) had tried to call Lukas, they would simply be told that Lukas could not be reached. She is fine with this message and immediately gets back to her work in order to finish before her train stops in Heidelberg.

Scene 2: Driving home from public transport through the city – picking up costumes

Sabine leaves the train. It has started to rain again, and Sabine all of a sudden remembers that it was her husband, Ulrich who had parked the car this morning. They work in different cities and therefore have to take different trains in the morning. Normally, Ulrich drives to work, but this morning he left the car (after Sabine had left the car to run for her train – she was late) at the parking facility so Sabine could drive home later that day. Ulrich was going on a business trip to Würzburg and had therefore preferred to take the train and to leave the car for Sabine so that she would be able to manage the home issues better. Sabine has no idea where the car is parked. She takes out her smart phone to see if she can get a map of the area and guidance to show her where the car is parked. She selects the car parking map service and immediately she can see the area and directions to the car. Ulrich had activated this service when he left the car this morning so Sabine would have easier access to the car – and the service could be chosen as an extra service when entering the car parking area.

Fortunately, the car isn't parked far away but far enough for her to get a bit wet. Getting into the car, Sabine activates the car computer and selects two addresses: the address for a special costume shop in the centre of Heidelberg (where she is to pick up a costume for Ulrich and herself for an upcoming costume party they are invited to) and then their home address. She knows this will optimize her way across the city and across the worst traffic jams and be the best chance of getting home before her small girls get home. When starting the car, she activates the windscreen. The windscreen was designed in such a way that the driver could select different tasks related to

applications or services that the car system could offer just by using his or her eyes. Tasks could be selected by directing your eye at a specific task, making it more convenient for the driver to carry out simple tasks when driving: it only took a short time to look away from the window and could be done without lifting your hands from the steering wheel. Sabine often used this feature to check up on her family members' whereabouts and to listen to specific voice mails or service messages from the car and had found it to be easy and safe to use. Leaving the parking lot, Sabine feels relaxed: the car is programmed to find the best way through the city to the shop where she will pick up the dress, she has activated the collision control and another parking alert to identify available parking spaces near the shop.

Machine-to-machine communications

After Sabine provides the car with her itinerary (costume shop, then home), the car immediately connects to the city's road traffic control system. This system receives information from sensors along all main roads and from cars about the current traffic flow in the city. Based on this information, the traffic lights in the city area are controlled to achieve maximum traffic flow. It also offers a service to find the quickest way to get to the destination. All this is going on in the background, while Sabine gets started on her trip.

At the same time, the car delivers its geographical position (GPS coordinates) to the parking lot's computer system and notifies the system that this place is now available for others. In this way, cars arriving at the parking area can be directed to the free space.

On the way to the costume shop, the car monitors its surroundings by means of radar and IR technology. The car also tracks its position on an electronic city map, which indicates areas where roadside parking is allowed. The car recognizes free spaces in these areas and marks them as free parking spaces. An update of this collected information is sent to the city's traffic centre. Sabine takes advantage of this service and chose a parking space close to the shop.

The radar system is also used to detect if any obstacles are in front of the car in order to avoid accidents. In the event of such a situation, the car is programmed to brake immediately thereby preventing an accident. To avoid that other cars crash into the braking vehicle, a data communication channel that constantly exchanges reports about the driving conditions with the cars in the neighbourhood is used. This exchange of information does not involve the driver and is designed to increase road safety. So, is a car brakes suddenly, this information is forwarded to the chain of cars driving behind.

Sabine gets to the centre of Heidelberg relatively easily in spite of the beginning rush hour. One km before the address where the she is to pick up the costumes, the car system comes up with suggestions for where she can park. More specifically, the car system suggests several parking spaces and asks if she would like to make a reservation for a particular space. She is lucky: Just as she enters the street where the shop is located, another car pulls out from a parking space near the shop. Sabine immediately accepts the invitation to reserve the space, and she knows that the car will then receive a special code that matches the available parking space. If another car were to approach this space – and perhaps just park there without a reservation – a loud alarm would go off and the parking personnel would approach the car to resolve the situation. Leaving the car – this time with her umbrella – she really appreciates this service that spares her from endless trips to the centre of the city looking for a parking space.

Starting the car again, the car computer system tells her (orally) that she has received a message from her husband, his trip to Würzburg will be long but he will be able to get home before midnight. She is happy to hear this and is thinking about this as she drives down the street suggested by the car computer system. Suddenly, the car stops! Another car in front of her has come to a sudden halt because of an accident involving a cyclist. Because of the rain, the autumn leaves

from the trees have made it risky for cyclists to cycle too fast. The cyclist has learnt this the hard way while trying to cut a corner and is now lying on the path and his bike has fallen out onto the road. A bigger accident has been avoided! Some pedestrians help the cyclist to his feet and remove his bike, and the cars can simply drive on. Sabine is very happy that the car collision control had worked since she had had no chance of seeing this coming.

Indian Traffic Jam

Amit starts from his house in Valasaravakkam in the west of Chennai. He has to go to Mylapore on the eastern part to his home. It is only about 15 km away. But it is the railway track that worries him. There in a railway track running North-South in the middle of the city. He can cross the track at one of the seven bridges in a span of 3 km along the track. There is usually heavy traffic at these bridges. When he reaches the junction where he has to take a decision, he asks his mobile device for advice. His mobile device contacts the server. The server gets information about the traffic speed and traffic density from the computer vision systems installed at the bridges. The server also gets other requests for route planning. Using this information, it predicts the traffic flow at bridges at the time Amit would reach the track. The server sends back advice on which bridge to use and how long it would take for him to clear the tracks. Now Amit knows how long it would take for him to reach his house. He calls home and gives an estimate for when he will be at home.

Just before she arrives home (500 m), the car communication system asks Sabine about her personal preferences for entering the house. She uses the windscreen again and selects (using her eyes) her personal preference profile in terms of housing temperature, lighting and music. Today she wants to listen to a band that one of her colleagues plays in. She received the music on her smart phone earlier and now transfers the music to her personal information base so that she can listen to it when she gets in. She gives the instructions for this using both the eye-tracking device and her voice – depending on the traffic and the task she is to carry out.

Scene 3: At home

Driving into the garage, a message beeps in and she is informed that Lukas is still playing in the games room and that her personal preferences contradict with Lukas' preferences for this room. She quickly rethinks her preferences and allows for Lukas' set-up of the games room to remain valid.

Then she enters the house. Closing the door, the music starts – the music Sabine selected in the car. It follows her around the house to the kitchen – (there is only sound in the rooms where she is present). Entering the room, the kitchen wall screen is activated (it is linked to her pre-selected house preferences) and messages from the supermarket are displayed. She quickly selects (by touching the screen) a message from the supermarket about a missing item in the groceries ordered yesterday. The missing item is a special sugar clown she would have liked to put on top of the cake she and Ulrich will bring to the costume party. The supermarket cannot deliver this sugar clown before the end of next week, so now she needs to find out whether she can do something else or just needs to forget about the idea. She interacts with the kitchen screen in order to transfer the communication to her mobile personal device. Then she places herself on the sofa in the living room. She now makes a search combining the stock list of groceries in the house with recipes (from

her favourite Internet web-sites) in order to see if she can make a sugar clown herself – given a time constraint on approximately 30 minutes.

Looking through different alternatives she finds a solution that requires icing sugar. It has been registered that icing sugar is within the house, and she can now plan when and how to make the alternative cake decoration – and that doesn't need to be today. She sits down again on the sofa and closes her eyes – it has been a long day. Suddenly she is warned by a loud message from her personal mobile device. The device has detected that she is resting and therefore automatically has switched to alternative messaging. The message is that her daughters are almost at home and that she can expect them to be there in a few minutes. It is by own choice that Sabine is being alerted in this way in spite of her resting. The arrival of her children has been set to as; "important", by Sabine herself.

In a village west of Xi'an, China

Jia and her grandmother wave again; Jia's mother, Chenyu, drives off in the family car towards the new shopping centre near Xi'an city. Jia is rather excited about this since her mother is on her way to buy things for the coming Spring Festival. Jia turns around and runs back towards the house. Her e-school session is set to start in approximately 20 minutes. The e-school had been established in order to support the smaller village schools in China, so that they would be able to get up-to-date information and material for teaching. It runs every afternoon for two hours – following the normal elementary school Jia attends physically every morning in the village. Jia is fortunate to be able to attend the extra e-school sessions at home; other children have to go to the actual school to share the same connection.

Jia's farther, Dingxian, is in the house taking a break from the responsibilities in the field. He is listening to the digital radio set up from the local village network. As soon as Jia comes into the living room, he switches off the digital radio with the single mobile phone in the house and starts talking with Jia – and later her grandmother – about school and the class Jia will be attending shortly. Jia is able to start up the e-school connection herself. She uses the house computer and the television to get access to the local network and enters her personal school code in the process to inform the school about her attendance.

Jia's grandmother looks at Jia and smiles while Jia starts taking notes on a piece of paper. The whole family has agreed to give Jia some money as a lunar New Year gift so that she – in time – will be able to get her own laptop. The grandmother sighs; what a difference compared to when she was young and was given a few extra pennies for sweets!

Sabine gets up and gets ready to greet the children at the door. Just as she leaves the room, she is reminded about the school meeting tonight. Well, with Ulrich away from home, she decides to take part in the meeting through their digital conference facilities. Using her personal mobile device she sends a message to the teacher that she will attend digitally. She knows that many other parents need to do this the same way, so the school digital conference facilities need to be able to accept up to 30 parents connecting in this way.

Sabine opens the door and immediately hears Lea shouting and yelling and showing something she has made at school. When Anna and Lea enter the house, Sabine's music stops and she can now listen to all the things her daughters want to tell her about their day. Sabine closes the door – the girls are already on their way to the kitchen to get something to eat and drink while shouting and talking about their day. Sabine follows and smiles – dinner, school meeting and more work – all that will have to wait till she has spent some time with her children.

7 USER REQUIREMENTS

The scenarios represent a long list of different user requirements – some common for all scenarios while others are relative to the context and situation in the scenarios. Crysler et al. (2004) developed a user focused reference model in which the users' basic needs are developed from Marslow's needs hierarchy (referred to as the value plane) and linked with the capability plane focusing on features of the wireless system. The dimensions from the reference model found again in the following list but with additional values and capabilities. In the following list there has been made a distinction between user preferences and system challenges as broader divisions than the above-mentioned reference model. There has been a need for this broadening, since there is a trend in the current societies that the average user knows more about IT and demands more of the technical features of the systems also. This trend is foreseen to take place even more over the coming years and can also be seen in the scenarios.

The following lists some of the most visible user requirements expressed in the scenarios:

- Social interaction

  To belong somewhere and to be able to be within interaction/communication range with others is important. This is a need evident for all users whether they are interacting in private, public or business relations. The social interaction needs to be available and possible regardless of time and place of the user (synchronous and asynchronous communication), and needs to support communication between one-to-one, one-to-many and many-to-many through different media.

- Control

  The user needs to be in control of the interactions with the device, the wireless system, services and applications used as well as the communications made with others (known or unknown to the user). Control extends to all parts of the wireless system to the personalised settings on the device and to push-services. Furthermore, it is essential that the user has the possibility to say "no" to a service or to just being present and available all the time. Lack of control raises anxiety and lower trust for most people interacting with wireless systems.

- Personalisation

  Closely related to the perspective or being in control, users must be able to personalise their interactions and their use of specific devices, services and applications. Personalisation is, in relation to communication and IT, a way of expressing preferences and personality and is as important for the user in relation to the user experience and the willingness to pay for a specific service.

- Privacy

  The need to express personality through interactions and communications calls for the securing of privacy. If users cannot rely on their personal data is secured, users may avoid interactions and communications through wireless connections. The need to take care of

privacy can extend the personalisation perspective to a need where the user can set personalised settings as context aware settings. This feature will secure some users privacy and personalisation and allow these users to interact more with the wireless system, services, applications etc.

- Security

  All humans need to feel secure in their interaction and communication with others. If they are not secure, they will withdraw and use alternative actions for communication. Even though security is important and essential for interaction and communication, it is also a feature that users traditionally do not want to spend too much time on managing (REF). Therefore, the security need for future wireless systems, applications and services is to be underlying and built into whatever system, device or application/service that the user wants to use. The security levels need to be non-jeopardizing to the user.

- Trust

  Trust is highly linked to a user's level of comfort and security using wireless systems, etc. Trust needs must be established through all kinds of interactions with the system and with receivers (users) at the other end. It must be clear to the user what takes place in the interaction and who has access to information. Furthermore, trust is central in particular in social relations and there is a need to establish different trust relations in web-based social networks as it is possible in face-to-face social networks.

- Self-actualization

  Users must be able to express themselves and share with others. What is seen currently in many web-based social network sites is that users are creative and dynamic and constantly challenge the service provider as well as national regulations in their interactions and postings. This is seen to be a common element in the future wireless system, applications and services.

- Human capability augmentation

  Wireless technologies should be developed to support and enhance users' capabilities covering physical and mental deficits, learning, networking, etc.

- Interfaces and interactions

  The users expect a change in the interactions and interfaces, which will allow for 3D experiences, divided screens and different input mechanisms which may seem more natural to the user. These may be text, speech, moving images, 3D, haptic, tactile, etc. into multimodal interactions.

- User experience

  Already now users want a good user experience interacting with wireless (and fixed) technologies and networks. This covers everything from the design, to the security, to QoS, price, personalisation possibilities, playfulness, feelings that the user has in the use and

interaction etc. The user experience is highly individual and calls for the possibility to personalise devices, but also services, billing, etc.

- Transparent billing and easy payment

  Mobility and nomadic behaviour are essential features of the future (and present) users. This requires that users can understand billing and payment systems and get no surprises when they return from a business trip or a holiday. Worldwide there should be good agreements between different service providers so that the user at all times pays what he/she is used to pay or at least is told if there is a deviation. The user should at all times be able to pay in an easy and secure way.

- Reliable connections

  All connections and interactions with wireless technologies and networks must be reliable, solid and with high QoS. This implies seamless communication across all networks.

- Preferred services always

  Users expect to be able to have the same services they use anywhere and anytime.

- Context aware services

  Services can be context aware and push services and most users expect this. However, the user must be in control and should be able to set levels for the push and context aware services (and be able to refuse the services)

- Easy search

  Across applications and programs on the Internet and on the user's personal devices

- Natural shift between devices

  The user should be able to shift in use between devices with an easy push on the buttons so that the user can transfer an interaction from one device to another device without experiencing any changes (perhaps only in size or display). The possibility should include that the user can watch the same services in the same way on all devices

- Affordable devices and Internet connections for all

  Price is a factor with a high influence on whether users can obtain and use wireless technologies also in the future. Therefore, there must be possibilities for all users to be able to pay devices and Internet connections for all.

- Services for all

  It is important that all services can be personalised to the needs of the user whether the user is a child in Africa, an older man in Australia or a businesswoman in the USA. Services need to be flexible and adaptable to fit into personal preferences.

- Intelligent support systems for secure transport and health services

For the sake of the environment and the security of the user, the scenarios assume that the future will include intelligent transport and health services.

- Intelligent housing systems

  Houses are already now relatively intelligent. It is assumed that the intelligent housing systems will be more visible and grow over the coming years.

- Single sign-on

  Presently users need to sign-on to many different applications and services during one day. Many users would prefer single sign-on.

- Easy handling of network admissions

  One obstacle of many networks is the set-up and handling of admissions. All users should be able to set-up their own profiles, accounts and administer home networks and connections to other networks. The procedures around the network set-up and administrations need to be substantially easier and friendlier to the user.

- Users as creators

  Today, users produce, interact, consume and share all types of content through different media. It is expected that the media convergence will be more progressed in the years to come, and that users need to be able to take advantage of this as well. This implies amongst others that the technology, applications and services are user friendly and that IPR relations and obstacles are dealt with.

- Battery time

  Batteries and how users get devices recharged needs to be easier and to adapt to different possibilities in relation to where the user is present.

The above list is in no way an all-inclusive list but just a glimpse of areas under discussion with other WWRF Working Groups during the scenario construction process.

8 CONCLUSIONS

This paper presents a number of worldwide, user focused scenarios for the year 2020 in which a variety of users interact with wireless systems and devices in daily life situations. The scenarios show a diverse world with changes in needs and possibilities from continent to continent. This situation can be seen already today but is in the scenarios foreseen to exist also in the future.

The WWRF vision assumes a highly developed wireless world but must be adapted to each individual country given the conditions on the infrastructure, the political systems, cultures, geographical conditions, economy and the users themselves. Some of the scenarios in this paper may not seem so advanced in relation to the user of wireless systems, but hopefully they seem likely and feasible.

Scenarios are one way of discussing requirements to future systems. Here focus has been placed on the user and on discussing user requirements. However, beneath every scenario, there are many different challenges and possibilities for supporting the users in their interactions. These challenges and possibilities have a technical character that needs to be developed. Many of the features expressed in the scenarios are possible already now. This does not mean that they are done with the technical background as today but that there are other technological means in the future. It may also mean that some features are possible technically at this moment but that the features need to be developed to the mass market.

It is the hope that the scenarios can be used to raise discussion and discuss new challenges on the user side as well as on the technology side of a wireless future.

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ANNEX: DRIVING FORCES AND FUNDAMENTAL DRIVERS

Driving forces for the scenarios (they will vary in importance between the different scenarios)(based on Karlson et al., 2003):

1. Developments will be more user driven
2. User mobility will increase
3. *The service and application market will grow*
4. User security, integrity and privacy will become more important
5. H*ealth related issues will become more central and important to the users*
6. There will a shortage of spectrum for certain applications
7. Environmental issues will become more important
8. *The wireless industry will grow*
9. There will be a worldwide positive development in the telecommunications and wireless sector
10. The market concentration in the wireless industry will change
11. The fight for market dominance in the wireless industry will intensify
12. *Short terminal usage time and complexity management will become increasingly important problems*
13. 3G will be implemented

Fundamental drivers (which will be assumptions and therefore present more or less in all scenarios)(based on Karlson et al., 2003):

a. *The need for mobility and communication will increase*
b. *The value and need for information and knowledge will increase*
c. Users will increasingly be in control when it comes to use of wireless technologies, through intuitive interactions with applications, services and devices
d. Services and applications will increasingly be more personalized, ambient-aware and adaptive (I-centric)
e. *Different user groups have different values and needs*
f. *Standardization will increase*
g. There will be an explosion in social group formation in very large networks (Reed's law)
h. Sensors are increasingly embedded in for example vehicles, transport systems, weather systems, and building infrastructures

i. Globalization will increase

j. Seamless devices will increasingly be available to users, groups of users, communities and machines (autonomously communicating devices) irrespective of place and network with agreed quality of service

k. Users, application developers, service and content providers, network operators, and manufacturers will increasingly be able to create new services and business models efficiently and flexibly, based on a component based open architecture of the wireless world

l. All devices will be part of the mobile Internet seamlessly connected via Internet Protocol, enabling inter-working and interoperability between heterogeneous networks with enhanced security and user privacy

m. There will be a shift towards knowledge industries

n. Attractive markets attract new entrants

o. Services and applications will be personalized, ambient-aware and adaptive (I-centric)

p. The variety of devices serving the users will be substantially increased

q. There will be increased need for taking care of cyber crimes

r. There will be an increasing demand for information and choices

s. Large and complex systems become increasingly difficult to control centrally

t. There will be an increased technology adaptation into everyday life

u. There will be an increased awareness of how to get access to appropriate levels for reliability, security and trustworthiness

v. Environmentalism and health concerns will increase

w. There will be an increased need for processing power

x. Air bandwidth will be affected by political decisions

y. The capacity in air will increase but slower than in fibre

z. Processing power will increase exponentially

aa. Market economy will prevail

bb. Democratization will increase

cc. Industries mature over time

dd. Companies strive towards monopoly

ee. Value chain will increase in complexity

ff. Communication between machines will grow faster than communication between humans

gg. Sensors and RFID tags will be added to increase the number of devices

hh. Battery capacity will increase slowly (usage time)

ii. Wireless infrastructure cost will fall slower than for electronics

jj. New service industries will emerge

kk. There will be a significant increase in machine-to-machine automation systems

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